REMARKS

Please reconsider this application in view of the above amendments and the following remarks. Applicant thanks the Examiner for carefully considering this application.

Disposition of Claims

Claims 1-5, 7-11, and 13-15 were pending in this application. By way of this reply, claim 4 has been canceled without prejudice or disclaimer. Thus, claims 1-3, 5, 7-11, and 13-15 are now pending in this application. Of these, claims 1 and 9 are independent. The remaining claims depend, directly or indirectly, from claim 1 or 9.

Claim Amendments

By way of this reply, independent claims 1 and 9 have been amended to include all of the limitations of claim 4 and further to clarify the claimed invention. Accordingly, claim 4 has been canceled without prejudice or disclaimer. Consistent with these amendments, claim 5 has been amended to depend from amended independent claim 1. No new matter has been added by way of these amendments, as support for these amendments may be found, for example, in paragraph [0018] of the published specification.

Rejection(s) Under 35 U.S.C. § 103(a)

Claims 1-3, 7, 8, 11, and 13 are rejected under 35 U.S.C. § 103 (a) as being unpatentable over U.S. Patent No. 6,441,403 ("Chang") and U.S. Patent No. 4,992,837 ("Sakai") in view of U.S. Patent Publication No. 2002/0093020 ("Edmond") and further in view of U.S. Patent No. 5,684,309

("McIntosh"). Further, claims 4 and 5 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Chang, Sakai, Edmond, and McIntosh in view of U.S. Patent No. 5,543,638 ("Nettelbladt").

As discussed above, by way of this reply, independent claim 1 has been amended to incorporate the limitations of claim 4 and further to clarify the claimed invention. Accordingly, claim 4 has been canceled without prejudice or disclaimer. Thus, with regard to claim 4, the rejection is now moot. Regarding the remaining claims, to the extent that the rejections may still apply to the amended claims, the rejection is respectfully traversed for the reasons set forth below.

As previously noted, one or more embodiments of the claimed invention are directed to a gallium nitride (GaN)-based compound semiconductor device. With reference to Figures 1 and 2, for example, the GaN-based compound semiconductor device has a GaN-based light emitting member 24 and a buffer layer 22. The light emitting member 24 further has a multilayer quantum well structure. Specifically, the light emitting member 24 has an InGaN well layer 24b and an AlInGaN barrier layer 24a. The compositional ratio of Al in the AlInGaN barrier layer 24a is 14% or greater and 40% or smaller, and the compositional ratio of In in the AlInGaN barrier layer 24a is 0.1% or greater and 5% or smaller. As a result, the light emission efficiency of the GaN-based compound semiconductor device becomes 2.6 times greater, and the GaN-based compound semiconductor device can provide a light emission whose wavelength is 375nm or shorter (*see, e.g.*, the published specification, paragraphs [0004] and [0032]).

Further, the light emitting layer 24 is formed by alternately layering an InGaN well layer 24b and an $Al_x In_y Ga_{1-x-y} N$ barrier layer 24a. Here, x and y are in the ranges of $0<x<1$ and $0<y<1$. The thickness of the InGaN well layer 24 is, for example, 1.5 nm and the thickness of the

AlInGaN barrier layer 24a is, for example, 12 nm. The pattern is repeated, for example, 7 times, for a total of 14 layers. When a single layer of InGaN layer is employed, it is fundamentally impossible to realize a light emission of a wavelength of 363 nm or shorter. By employing the MQW structure in which the well layer and the barrier layer are alternately layered, it is possible to widen an effective band gap of the InGaN well layer 24b. With the widening of the effective band gap, light emission at a wavelength of 363 nm or shorter can be enabled. Because a composition of In in the InGaN well layer 24b which is the light emitting region is relatively high (for example, composition x of In =10%) and fluctuation in In composition in the InGaN well layer 24b is large, the light emission efficiency is high. More specifically, when there is a spatial fluctuation in the composition, carriers are localized and the light emission efficiency tends not to be reduced even when dislocations are created in InGaN (*see, e.g.,* the published specification, paragraph [0018]).

Accordingly, independent claim 1 requires, in part, the limitations, (i) a compositional ratio of Al in the AlInGaN barrier layer is 14% or greater and 40% or smaller, and a compositional ratio of In in the AlInGaN barrier layer is 0.1% or greater and 5% or smaller, (ii) the GaN-based light emitting member emits ultraviolet light having a wavelength of 375 nm or shorter, and (iv) *the multilayer comprises at least two of the InGaN well layers and two of the AlGaN barrier layers, in which the AlGaN well layers and AlGaN barrier layers are alternately layered, and a thickness of each of the InGaN well layer is 1 nm or greater and 2 nm or smaller.*

In contrast, Chang, Sakai, Edmond, McIntosh, and Nettelbladt whether considered separately or in combination, fail to show or suggest at least the above limitations.

Chang generally discloses an AlInGaN buffer layer without teaching a specific composition ratio of Al and In in the AlInGaN buffer layer. Further, Sakai discloses a super-lattice structure of

an active layer and clad layers (*see* Sakai, column 7, lines 7-11). Further, Edmond teaches that the wavelength of light is based on an energy bandgap (*see* Edmond, paragraph [0006]). Furthermore, McIntosh teaches that the barrier layers 11a, 11b, and 11c may be formed on aluminum gallium nitride or aluminum indium gallium nitride (*see* Edmond, column 5, lines 1-5).

However, as the Examiner acknowledged in the Final Office Action dated April 3, 2009, none of the above references shows or suggests, at least, the limitation "*a thickness of each of the InGaN well layer is 1 nm or greater and 2 nm or smaller,*" as required by the claimed invention.

However, the Examiner asserts that Nettelbladt shows the above feature that which Chang, Sakai, Edmond, and McIntosh lack with respect the claimed invention.

Applicant respectfully disagrees. Nettelbladt teaches a semiconductor light emitting device, including an active layer and barrier layers. However, Nettelbladt neither shows, nor suggests, at least the specific range of the thickness "*1 nm or greater and 2 nm or smaller*" of each of the InGaN well layers. Instead, Nettelbladt exemplify the active layer having the thickness of 10 nm, which is clearly outside of the range for the thickness of the InGaN well layer recited in the claims. Further, Nettelbladt fails to show or suggests that any specific range of the thickness of the InGaN well layers, as being associated with the feature of "*the multilayer..., in which the AlGaN well layers and AlGaN barrier layers are alternately layered,*" as required by the claimed invention.

Applicant respectfully notes that one of the advantages of the claimed invention is that when there is a spatial fluctuation in the composition, carriers are localized and, therefore, the light emission efficiency tends not to be reduced even when dislocations are created in InGaN. To achieve the unique characteristic as a light emitting device, the range "*1 nm or greater and 2 nm or smaller*" as the thickness of each InGaN well layer is inseparably associated with the specific

multilayer structure that *comprises at least two of the InGaN well layers and two of the AlGaN barrier layers, in which the AlGaN well layers and AlGaN barrier layers are alternately layered,* as required by the claimed invention.

In contrast, Nettelbladt teaches nothing more than that the fundamental wavelength of the quantum well is determined by the energy bandgap of the material and the thickness of the material (*see* Nettelbladt, column 4, lines 8-10).

Accordingly, Nettelbladt fails to show or suggest, at least, the limitations "*the multilayer comprises at least two of the InGaN well layers and two of the AlGaN barrier layers, in which the AlGaN well layers and AlGaN barrier layers are alternately layered, and a thickness of each of the InGaN well layer is 1 nm or greater and 2 nm or smaller,*" as required by the claimed invention.

In view of above, Chang, Sakai, Edmond, McIntosh, and Nettelbladt, whether taken separately or in combination, fail to show or suggest the invention as recited in independent claim 1, as amended. Thus, amended independent claim 1 is patentable over Chang, Sakai, Edmond, McIntosh, and Nettelbladt. Dependent claims 1-3, 5, 7, 8, 11, and 13 are allowable for at least same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

Claims 9 and 10 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Chang in view of Sakai and further in view of Edmond. As discussed above, independent claim 1, as amended, is patentable over Chang, Sakai, Edmond, McIntosh, and Nettelbladt. By way of this reply, independent claim 9 has been also amended to clarify the claimed invention, and includes substantially similar limitations to that of amended independent claim 1.

In view of the similarity between the limitations of independent claim 9 and the limitations discussed above with respect to independent claim 1, Applicant respectfully submits that the foregoing arguments as to the patentability of independent claim 1 also demonstrate the patentability of independent claim 9. As such, it is respectfully submitted that independent claim 9 are patentably distinguishable over the cited references at least for reasons analogous to those presented above. Claim 10 is allowable for at least same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

Claims 14 and 15 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Chang in view of Sakai and Edmond and further in view of U.S. Patent Publication No. 2003/0047744 ("Yanamoto").

As explained above, Chang, Sakai, and Edmond, whether taken separately or in combination, fail to show or suggest the invention as recited in independent claim 1.

Yanamoto fails to supply that which Chang, Sakai, and Edmond lack. In fact, Yanamoto only teaches p-type and n-type clad layer composed of ALGaN (*see* Yanamoto, paragraphs [0070]-[0072] and [0081-[0083]).

Accordingly, Chang, Sakai, Edmond, and Yanamoto, whether considered separately or in combination, fail to show or suggest all of the limitations, as required by independent claim 1.

In view of above, independent claim 1 is patentable over Chang, Sakai, Edmond, and Yanamoto. Claims 14 and 15 are allowable for at least same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

Conclusion

Applicant believes this reply is fully responsive to all outstanding issues and places this application in condition for allowance. If this belief is incorrect, or other issues arise, the Examiner is encouraged to contact the undersigned or his associates at the telephone number listed below. Please apply any charges not covered, or any credits, to Deposit Account 50-0591 (Reference Number 08228/071001).

Dated: September 3, 2009

Respectfully submitted,

By____________________

Thomas K. Scherer
Registration No.: 45,079
OSHA · LIANG LLP
909 Fannin Street, Suite 3500
Houston, Texas 77010
(713) 228-8600
(713) 228-8778 (Fax)
Attorney for Applicant